

REMARKS

The Office Action mailed November 5, 2002, has been received and reviewed. Claims 1-20 are currently pending in the application, of which claims 1-11 are currently under examination. Claims 12-20 are withdrawn from consideration as being drawn to a non-elected invention and, as such, have been canceled. The Office Action Summary states that claims 1-11 stand rejected. However, the body of the Detailed Action states that claims 1-7 and 9-12 are rejected but yet provides reasons for the rejection of claim 8. Applicants also note that claim 12 has been withdrawn from further consideration as being drawn to a non-elected invention. Therefore, Applicants proceed under the assumption that claims 1-11 are rejected in the outstanding Office Action. Applicants respectfully request reconsideration of the application in light of the arguments presented herein.

35 U.S.C. § 102(b) Anticipation Rejections**Anticipation Rejection Based on U.S. Patent No. 5,766,997 to Takeuchi**

Claims 1-11 stand rejected under 35 U.S.C. § 102(b) as being anticipated by U.S. Patent No. 5,766,997 issued to Takeuchi. Applicants respectfully traverse this rejection, as hereinafter set forth.

A claim is anticipated only if each and every element as set forth in the claim is found, either expressly or inherently described, in a single prior art reference. *Verdegaal Brothers v. Union Oil Co. of California*, 2 U.S.P.Q.2d 1051, 1053 (Fed. Cir. 1987). The identical invention must be shown in as complete detail as is contained in the claim. *Richardson v. Suzuki Motor Co.*, 9 U.S.P.Q.2d 1913, 1920 (Fed. Cir. 1989).

Takeuchi discloses a method of forming local interconnect structures that comprises, *inter alia*, forming a discrete titanium layer and a discrete titanium nitride layer on a silicon substrate. The titanium layer is formed by chemical vapor deposition and the titanium nitride layer is formed by "reactive sputtering at the ratio of 0.5 to 3% by weight of N₂ and 97 to 99.5% by weight of Ar." Column 17, lines 3-12.

Claim 1 recites a source structure for a local interconnect. The source structure comprises a semiconductor substrate, a nitrogen-rich Ti layer overlying a portion of the semiconductor

substrate, a refractory metal layer overlying the nitrogen-rich Ti layer, and a silicon layer overlying the refractory metal layer. The nitrogen-rich Ti layer has a nitrogen-rich upper portion that is not pure titanium nitride and a titanium lower portion that is substantially nitrogen-free.

Takeuchi does not anticipate claim 1 because it does not expressly or inherently describe each and every element of claim 1. Specifically, Takeuchi does not disclose “a nitrogen-rich Ti layer having a nitrogen-rich upper portion and a titanium lower portion, wherein the nitrogen-rich upper portion is not pure titanium nitride, [and] the titanium lower portion is substantially nitrogen-free.”

Takeuchi does not expressly or inherently describe a nitrogen-rich Ti layer having a nitrogen-rich upper portion that is not pure titanium nitride and a titanium lower portion that is substantially nitrogen-free. The Examiner argues that titanium nitride layer 137 is equivalent to the nitrogen-rich upper portion that is not pure titanium nitride. Office Action of November 5, 2002, p. 3. However, nothing in Takeuchi expressly or inherently describes that titanium nitride layer 137 is not pure titanium nitride. As such, titanium nitride layer 137 is not properly characterized as a nitrogen-rich upper portion that is not pure titanium nitride, as recited in claim 1.

The Examiner states that “layer (137) is titanium with 0.5 to 3% by weight of N_2 ” and, therefore, “it is inherent that . . . nitrogen-rich layer (137) is not pure titanium nitride because pure titanium nitride (TiN) has more weight % of N_2 .” Office Action of November 5, 2002, p. 3. By this statement, the Examiner appears to imply that titanium nitride layer 137 in Takeuchi has 0.5 to 3% by weight of nitrogen. However, Takeuchi actually discloses that titanium nitride layer 137 “is formed . . . by reactive sputtering at the ratio of 0.5 to 3% by weight of N_2 and 97 to 99.5% by weight of Ar.” Column 17, lines 3-1. The “0.5 to 3% by weight of N_2 ” is one of the process conditions used to deposit the titanium nitride layer 137 by reactive sputtering and does not establish that “layer (137) is titanium with 0.5 to 3% by weight of N_2 .” Rather, as described in Takeuchi, layer 137 is a titanium nitride layer. Column 17, lines 7-12. Since the layer is, in fact, titanium nitride, it is improper to characterize layer 137 as being “titanium with 0.5 to 3% by weight of N_2 .” Furthermore, contrary to the Examiner’s assertions, molecular nitrogen, N_2 , is not present in layer 137 because during the reactive sputtering process, the molecular nitrogen is

dissociated into atoms of nitrogen, which react with the titanium to form titanium nitride layer 137. Therefore, the Examiner's assertion that titanium nitride layer 137 is not pure titanium nitride because it includes 0.5 to 3% by weight N_2 is erroneous.

In addition, if the Examiner's argument was followed to its logical end, the titanium nitride layer 137 would include 97 to 99.5% by weight of Ar in addition to the 0.5 to 3% by weight of N_2 , for a total of 100%. The resulting "titanium nitride" layer would include N_2 and Ar but would not include any titanium nitride.

Takeuchi also does not expressly or inherently describe a nitrogen-rich Ti layer that has a nitrogen-rich upper portion and a titanium lower portion. The Examiner argues that layers 136 and 137 of Takeuchi are equivalent to the nitrogen-rich Ti layer of the present invention. Office Action of November 5, 2002, p. 3. However, the nitrogen-rich Ti layer of the present invention is a single layer that has both a nitrogen-rich upper portion and a titanium lower portion. The layers 136 and 137 of Takeuchi are discrete layers, each of which comprises a homogenous material. Namely, layer 136 is a homogenous layer of titanium and layer 137 is a homogenous layer of titanium nitride. Since layers 136 and 137 are both separate, homogenous layers, neither is an upper portion or a lower portion of a nitrogen-rich Ti layer. Furthermore, layer 136 is not the nitrogen-rich Ti layer because layer 136 is a titanium layer and does not contain nitrogen. Titanium nitride layer 137 also is not the nitrogen-rich Ti layer because layer 137 is titanium nitride and is not a titanium layer that is rich in nitrogen. Therefore, these layers are not properly characterized as a nitrogen-rich Ti layer having a nitrogen-rich upper portion and a titanium lower portion.

Since Takeuchi does not describe "a nitrogen-rich Ti layer having a nitrogen-rich upper portion and a titanium lower portion, wherein the nitrogen-rich upper portion is not pure titanium nitride, [and] the titanium lower portion is substantially nitrogen-free," as recited in claim 1, Applicants respectfully submit that the anticipation rejection of claim 1 be withdrawn.

Claims 2-11 depend from claim 1 and, therefore, include all of the limitations of allowable claim 1. Claims 2-11 are allowable, *inter alia*, as depending from an allowable claim 1.

Claim 3 is further allowable because Takeuchi does not expressly or inherently describe

that the nitrogen-rich Ti layer is disposed over active areas of the silicon substrate.

Claim 4 is further allowable because Takeuchi does not expressly or inherently describe that the nitrogen-rich upper portion extends along an upper surface of the nitrogen-rich Ti layer.

Claim 5 is further allowable because Takeuchi does not expressly or inherently describe that the titanium lower portion contains substantially no nitrogen.

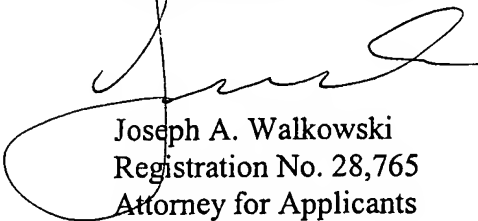
Claim 6 is further allowable because Takeuchi does not expressly or inherently describe that the nitrogen-rich upper portion is from about 50Å to about 100Å thick.

Claim 7 is further allowable because Takeuchi does not expressly or inherently describe that the nitrogen-rich Ti layer is from about 100Å to about 300Å thick.

CONCLUSION

Claims 1-11 are believed to be in condition for allowance, and an early notice thereof is respectfully solicited. Should the Examiner determine that additional issues remain which might be resolved by a telephone conference, he is respectfully invited to contact Applicants' undersigned attorney.

Respectfully submitted,



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